Monitoring Data

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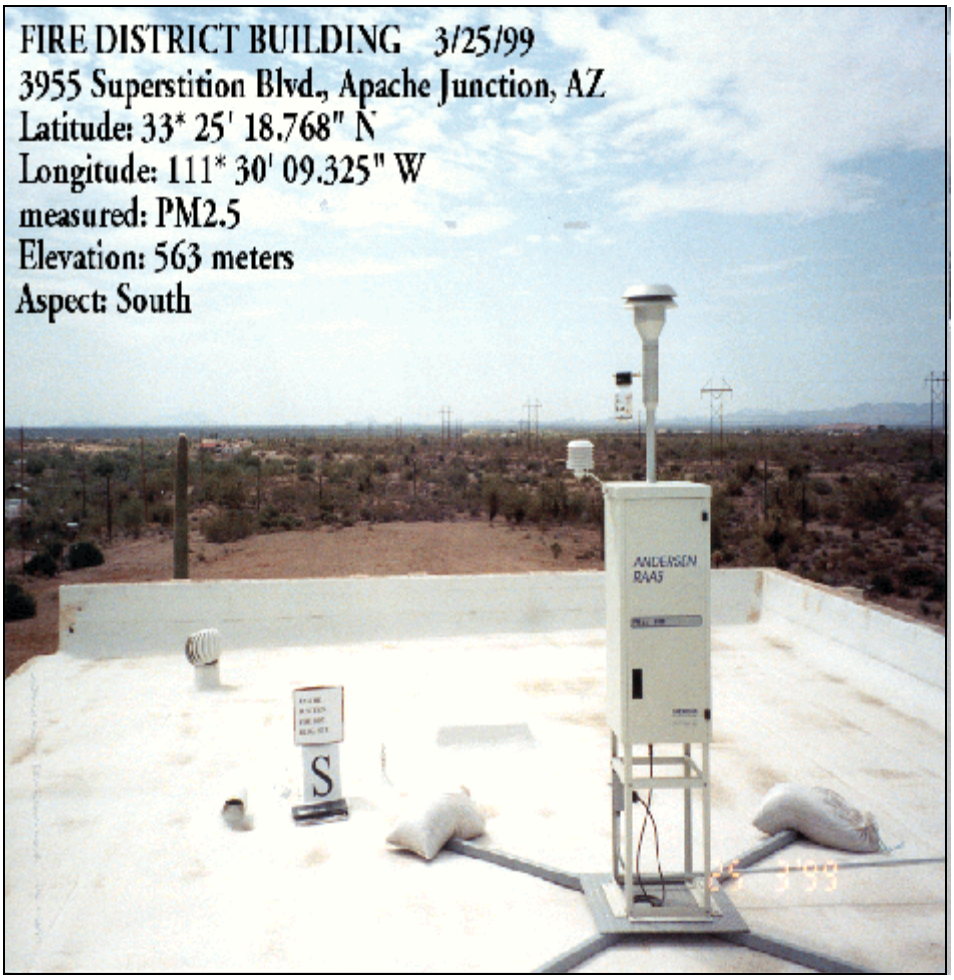


Particulate Matter $_{2.5}$ Monitoring Site
Apache Junction, Arizona

Introduction

Air quality measurements in Arizona can be divided into the three categories of conventional pollutants, visibility and photochemical monitoring. Each category is discussed below. EPA has set national ambient air quality standards for the criteria air pollutants, which are carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide, lead and particulate matter 10 microns in size and smaller (PM_{10}). Additional particulate matter monitoring includes the two subsets of PM_{10} of coarse (2.5 to 10 microns in size) and fine (less than 2.5 microns in size) particulate matter. These pollutants are monitored in Arizona by industry, county air pollution districts, Indian tribes and ADEQ. The 2000 data measurements by conventional pollutant begin on Page 20. The data tables in this section are organized by county; site operator information can be found in the site index tables in Supplement A, which begins on Page 111. Data recovery information

(number of valid samples) is included in the tables. The number of valid samples is important for determining the representativeness of the average data calculations. Information about the compliance requirements and status for the criteria pollutants begins on Page 46. Visibility monitoring information is presented beginning on Page 72.

Conventional Pollutants, 2000 Data

Carbon Monoxide

Carbon monoxide – a colorless, odorless and tasteless gas that is produced in the incomplete combustion of fuels – has a variety of adverse health effects that arise from its ability to chemically bind with blood hemoglobin. Carbon monoxide successfully competes with oxygen for binding with hemoglobin and thereby impairs oxygen transport. This impaired transport leads to several central nervous system effects, such as the impairment of time interval discrimination, changes in relative brightness thresholds, increased reaction time, and headache, fatigue and dizziness. Carbon monoxide exposures also contribute to or exacerbate arteriosclerotic heart disease.

In Arizona's metropolitan areas, about 75 percent of carbon monoxide emissions come from on-road motor vehicles, 20 percent from off-road vehicles or equipment such as construction vehicles and lawn and garden equipment, and 5 percent from fuel combustion from commercial and residential heating. This pollutant has low background levels, with highest concentrations next to busy streets, and has elevated neighborhood concentrations in locations that reflect emissions transported from upwind portions of an area. Its concentrations peak from November to January because its emissions are highest in cold weather – automotive emissions of carbon monoxide vary inversely with temperature – and because the surface layer of the atmosphere is at its most stable in wintertime. Hourly concentrations tend to be at their maximum during morning rush hour and between 6 p.m. and midnight.

Controls have reduced carbon monoxide emissions and the standards have been achieved in the metropolitan Phoenix area in 1996-2000, in stark contrast to the first half of the 1980s, when more than 100 exceedances were recorded each year. Similar improvements have occurred in Tucson, where the last exceedance was recorded in 1984. Equipping vehicles with catalytic converters and electronic ignition systems were the most effective controls, but significant reductions can

also be attributed to the Vehicle Inspection Program (beginning in 1976) and oxygenated fuels (beginning in 1989).

Carbon monoxide is monitored continuously with non-dispersive infrared instruments that are deployed in urban neighborhoods and near busy roadways or intersections. In 2000, 15 monitors were operated in greater Phoenix, five in Tucson, and one each in Apache Junction and Casa Grande. Table 5 presents the 2000 carbon monoxide data.

Table 5. 2000 Carbon Monoxide Data (in ppm)					
Site or City	One-Hour Avg Value		Eight-Hour Avg Value		Valid Hour Samples
	Max Value	2nd High	Max Value	2nd High	
Cochise County					
Douglas, ADOT (Closed 02/14/00) #	4.4	4.1	2.5	2.4	1,087
Douglas, Cemetery (Closed 02/14/00) #	5.8	5.5	2.3	2.2	1,247
Maricopa County					
Central Phoenix	8.1	8.0	5.3	5.0	8,490
Gilbert [s]	3.7	3.3	2.0	2.0	2,155
Glendale [s]	4.6	4.6	3.5	3.2	4,876
Maryvale [s]	9.3	9.1	7.0	7.0	4,546
Mesa [s]	6.0	5.1	4.3	3.4	5,030
North Phoenix [s]	6.0	5.9	3.1	3.1	4,973
Phoenix, Grand Avenue	10.5	10.5	6.0	6.0	5,053
Phoenix, Greenwood – MCESD	8.1	8.1	5.6	5.6	8,288
Phoenix, JLG Supersite	9.1	7.9	6.9	6.4	8,679
Phoenix, West Indian School	11.9	8.9	6.8	6.7	8,602
South Phoenix [s]	10.0	8.4	5.9	4.7	4,751
South Scottsdale [s]	5.0	4.9	3.3	3.1	4,733
Tempe, MCESD #	5.0	4.6	3.7	3.5	4,852
West Chandler [s]	5.7	3.8	2.5	2.3	4,426
West Phoenix	10.6	10.4	7.4	7.2	8,585
Pima County					
Tucson, Alvernon	8.9	7.5	5.0	4.7	8,728
Tucson, Cherry	5.3	5.0	3.7	3.3	8,130
Tucson, Children's Park	3.8	3.5	1.9	1.9	8,722

Table 5. 2000 Carbon Monoxide Data (in ppm)					
Site or City	**One-Hour Avg Value**		**Eight-Hour Avg Value**		**Valid Hour Samples**
	Max Value	**2nd High**	**Max Value**	**2nd High**	
Tucson, Craycroft – PDEQ	5.4	5.4	2.7	2.4	8,479
Tucson, Downtown	6.7	6.0	3.8	3.5	8,675
Pinal County					
Apache Junction, Maintenance Yard	1.4	1.3	0.6	0.6	8,543
Casa Grande, Airport	2.4	2.2	0.9	0.8	8,416

s – Seasonal monitoring
 # – Less than 75 percent data recovery available in one or more calendar quarters

Lead

Lead, a heavy metal with pronounced toxic effects, is present in the atmosphere as a constituent of fine particles. Chronic lead poisoning attacks the blood, the brain and nervous system, the kidney, and the reproductive system, with such effects as moderate to severe brain and kidney damage, sterility, and abortions, stillbirths and neonatal deaths. Low-level chronic exposure to lead manifests itself first in the inhibition of the biosynthesis of hemoglobin, resulting in the anemia associated with chronic lead poisoning.

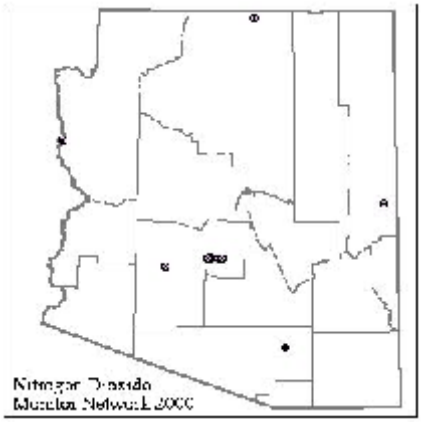
Emissions of lead in Arizona come from the smelting of ore, the combustion of fossil fuels and, until the mid-1970s, the use of alkyl lead compounds as anti-knock additives in gasoline. With the phasing out of regular lead gasoline, the automotive emissions of lead to the atmosphere have declined to near zero.

Controls to reduce lead emissions have been extremely effective, with a net 94 percent reduction on a national basis from 1978 to 1987. Automotive emissions were reduced 97 percent through the elimination of lead compounds in gasoline, stationary source fuel combustion emissions were reduced 92 percent, and industrial processes and solid waste disposal emissions were reduced substantially as well.

Lead is monitored by analyzing PM_{10} samples collected for 24 hours on every sixth day. Total suspended particulate (TSP) samplers are the reference method but are no longer used to obtain lead data. Lead is primarily a combustion product, so PM_{10} samples capture ambient lead concentrations adequately. Of the 16 sites where lead was detected in 2000, four are urban (Phoenix, Douglas, Payson and Nogales), three are located near a smelter (Hayden) or cement plant (Clarkdale), and nine are background sites (Petrified Forest NP, Chiricahua NM, Grand Canyon-Hance, Grand Canyon-Indian Gardens, Tonto, NM, Palo Verde, Organ Pipe Cactus, NM, and Hillside).

Quarterly lead averages are not included here but are available on request.

Nitrogen Dioxide



Nitrogen dioxide (NO_2) is a reddish-brown gas that is formed by the oxidation of nitric oxide (NO), which is a byproduct of combustion of all fuels. At the lowest nitrogen dioxide exposure levels at which adverse health effects have been detected, respiratory damage has been observed: destruction of cilia, alveolar tissue disruption, and obstruction of the respiratory bronchioles. Animal studies suggest that nitrogen dioxide may be a causal or aggravating agent in respiratory infections. Community exposure studies to lower ambient levels of nitrogen dioxide, however, have demonstrated no significant links with respiratory symptoms or disease. This pollutant is of greater concern in its reduction of visibility (it causes 5 percent of the visibility reduction in Phoenix) and in its contributory role in the photochemical formation of ozone.

Combustion emissions of nitrogen oxides are 95 percent nitric oxide and 5 percent nitrogen dioxide. Because nitric oxide is rapidly oxidized to nitrogen dioxide, nitric oxide emissions serve as a surrogate for nitrogen dioxide. In a recent Phoenix emissions inventory, the transportation sector dominated nitric oxide emissions: 58 percent of the emissions came from cars and trucks, 27 percent came from off-road vehicles such as trains and diesel-powered construction vehicles, and 15 percent from other sources, including power plants, biogenic emissions from soil, and stationary combustion sources. Nitric oxide and nitrogen dioxide concentrations are highest near major roadways. Nitric oxide concentrations decrease rapidly with distance from the roadway, whereas nitrogen dioxide concentrations are more evenly distributed because of their formation through oxidation and their subsequent transport. Concentrations of nitrogen dioxide are highest in the late afternoon and early evening of winter, when rush-hour emissions of nitric oxide are converted to nitrogen dioxide under relatively stable atmospheric conditions. Because nitric oxide reacts rapidly with ozone, nocturnal ozone concentrations in cities are often reduced to near-zero levels. This nitric oxide scavenging of ozone does not occur in remote areas. Nocturnal ozone concentrations at background sites are high compared with the urban concentrations.

Nitrogen oxides emissions from motor vehicles have been reduced through retardation of spark timing, lowering the compression ratio, exhaust gas recirculation systems, and three-way catalysts. The Vehicle Inspection and Maintenance Program, with its NOx test for light-duty gasoline vehicles 1981 and newer (in Phoenix only) and its opacity test for diesel vehicles, has also helped. Reformulated gasolines also decrease nitrogen oxides emissions: Federal Phase II

gasoline, by 1.5 percent for vehicular and 0.5 percent for off-road equipment; California Phase 2 gasoline, by 6.4 percent for vehicular and 7.7 percent for off road equipment.

Nitrogen dioxide (NO_2) is monitored continuously with chemiluminescence instruments, which also determines nitric oxide (NO) concentrations and NOx (the sum of NO_2 and NO) concentrations. These instruments are located in urban neighborhoods where either the emissions are dense or where ozone concentrations tend to be at their maximum. In addition, these monitors are located near major coal-fired electrical power plants. Twelve monitors were operated in Arizona in 2000: eight urban sites and four sites near power plants. Table 6 presents the nitrogen dioxide data collected in Arizona in 2000.

Table 6. 2000 Nitrogen Dioxide (in ppm)

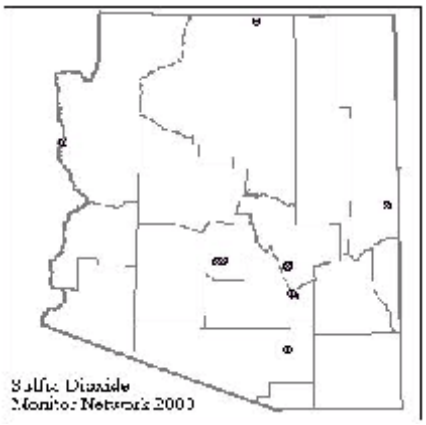
Site or City	Annual Avg	Maximum Value		Valid Hour Samples
		One-Hour Avg	24-Hour Avg	
Apache County				
Springerville, Coyote Hills	0.001	0.021	0.005	7,858
Coconino County				
Page	0.002	0.041	0.014	8370
Maricopa County				
Cental Phoenix	0.031	0.148	0.096	8,244
Palo Verde	0.003	0.032	0.010	3,804
Phoenix, Greenwood – MCESD	0.036	0.164	0.083	8,425
Phoenix, JLG Supersite	0.025	0.131	0.056	8,224
South Scottsdale	0.030	0.267	0.141	8,502
Tempe, MCESD #	0.022	0.062	0.040	3,653
West Phoenix	0.029	0.244	0.140	8,287
Mohave County				
Bullhead City, SCE	0.009	0.155	0.033	8,628

Table 6. 2000 Nitrogen Dioxide (in ppm)				
Site or City	**Annual Avg**	**Maximum Value**		**Valid Hour Samples**
		One-Hour Avg	**24-Hour Avg**	
Pima County				
Tucson, Children's Park	0.016	0.061	N/A	8,666
Tucson, Craycroft – PDEQ	0.017	0.075	N/A	8,532

 # – Less than 75 percent data recovery in one or more calendar quarters
N/A – Not Available

Sulfur Dioxide

Exposure to sulfur dioxide, a colorless gas with a pungent, irritating odor at elevated concentrations, alters the mechanical function of the upper airway, including increasing the nasal flow resistance and decreasing the nasal mucus flow rate. Short-term exposures result in an exaggerated air flow resistance in about 10 percent of the subjects tested and produce acute bronchioconstriction in strenuously exercising asthmatics.



In Arizona the principal source of sulfur dioxide emissions has been the smelting of sulfide copper ore. Most fuels contain trace quantities of sulfur, and their combustion releases both gaseous sulfur dioxide (SO_2) and particulate sulfate (SO_4^-). A recent sulfate inventory for Phoenix shows 32 percent of SO_2 emissions come from point sources, 26 percent from area sources, 23 percent from off-road vehicles and equipment, and 19 percent from on-road motor vehicles. Sulfur dioxide is removed from the atmosphere through dry deposition on plants and its conversion to sulfuric acid and eventually to sulfate. Sulfur dioxide has extremely low background levels, with elevated concentrations found downwind of large point sources. Concentrations in urban areas are low and are homogeneously distributed, with annual averages varying from 3 to 11 $\mu g/m^3$.

Major controls were installed in Arizona's copper smelters in the 1980s, which reduced sulfur dioxide emissions substantially. Vehicular emissions of sulfur dioxide and sulfate have been reduced through lowering the sulfur content in diesel fuel and gasoline.

Sulfur dioxide is monitored continuously with pulsed fluorescence instruments, most of which are clustered around copper smelters or coal-fired electric power plants. In 2000, nine reporting monitors were sited near copper smelters, three near power plants and three in urban areas. Table 7 presents the sulfur dioxide data collected in Arizona in 2000.

Table 7. 2000 Sulfur Dioxide (in Fg/m^3)				
Site or City	**Annual Avg**	**Maximum Value**		**Valid Hourly Samples**
		Three-Hour Avg	**24-Hour Avg**	
Apache County				
Springerville, Coyote Hills	0.65	47	11	7,718
Coconino County				
Page	0.59	14	7	6,691
Gila County				
Hayden, Garfield Ave.	21	860	284	8,784
Hayden, Junction	13	427	90	8,778
Hayden, Montgomery Ranch	41	799	210	8,767
Hayden, Old Jail – ADEQ	17	322	72	8,106
Hayden, Old Jail – ASARCO	13	342	63	8,783
Miami, Jones Ranch	11	895	133	8,554
Miami, Ridgeline – ADEQ	16	309	70	8,472
Miami, Town Site	8	483	76	8,776
Winkleman	38	772	218	8,784
Maricopa County				
Central Phoenix	5	68	39	7,873
South Scottsdale	3	52	47	7,941
Mohave County				
Bullhead City, SCE	6	17	52	8,556
Pima County				
Tucson, Craycroft – PDEQ	6	29	21	8,525

Ozone

Ozone – a colorless, slightly odorous gas – is both a natural component of the atmosphere, through its photochemical formation from natural sources of methane, carbon monoxide, hydrocarbons and nitrogen oxides, and an important air contaminant in urban atmospheres. In the stratosphere, ozone blocks harmful ultraviolet radiation. In the urban atmosphere, its formation from anthropogenic emissions of hydrocarbons and nitrogen oxides leads to concentrations harmful to people, animals, plants and materials. Ozone causes significant physiological and pathological changes in both animals and humans at concentrations present in many urban environments. Short-term (one to two hours) exposures to concentrations in the range of 0.1 to 0.4 parts per million induce changes in lung function, including increased respiratory rates, increased pulmonary resistance, decreased tidal volumes and changes in lung mechanics. Symptomatic responses in exercising adults include throat dryness, chest tightness, substernal pain, cough, wheeze, pain on deep inspiration, shortness of breath, and headache. These symptoms also have been observed at lower concentrations for longer exposures. Evidence suggests that ozone exposure makes the respiratory airways more susceptible to other bronchioconstrictive challenges. Animal studies suggest that ozone exposure interferes with or inhibits the immune system. Ozone at ambient concentrations injures the stomates, which are the cells that regulate plant respiration, resulting in flecks on the upper leaf surfaces of dichotomous plants and the death of the tips of coniferous needles. Ozone is considered by plant scientists to be the most important of all of the phytotoxic air pollutants, causing over 90 percent of all plant injury from air pollution on a global basis.

Ozone is formed photochemically by the reaction of volatile organic compounds and nitrogen oxides. Volatile organic compound (VOC) emissions in greater Phoenix come from cars and trucks (31 percent), off-road vehicles and equipment such as lawn mowers (27 percent), small stationary sources (20 percent), biogenic emissions from grass, shrubs and trees (17 percent), and point sources (5 percent). Nitrogen oxides (NOx) come from cars and trucks (58 percent), off-road vehicles such as construction equipment and trains (27 percent), electric power plants (7 percent), small stationary sources (4 percent), and biogenic emissions from soil (4 percent). Ozone has relatively high background levels, with the daily maximum in remote areas being about one-half to three-quarters of the daily maximum in the urban areas. In an urban area, the highest ozone concentrations tend to occur on the downwind edge, although high concentrations do occur less frequently in the central city. High ozone concentrations are a summer phenomenon caused when sunlight and evaporative hydrocarbon emissions peak. Ozone

concentrations are low to near zero at night, rise rapidly through the morning and peak in the afternoon.

Controls to reduce the precursors of ozone – VOC and NOx – have been successfully implemented for years. NOx and exhaust VOC from vehicles have been reduced through engine modifications and three-way catalytic converters. Evaporative hydrocarbons from vehicles have been reduced through better engineered fuel tanks and auxiliary plumbing combined with carbon absorption canisters. Additional reductions of vehicular VOC have come through the Vehicle Inspection Program, which tests all gasoline vehicles for hydrocarbons (Phoenix and Tucson), through vapor-capturing equipment for gasoline tankers, through vapor recovery systems at retail gas stations (Phoenix area only), and through reformulated gasoline (Phoenix area only). Stationary source hydrocarbons have been reduced through a variety of better control equipment required by stricter regulations. Despite these efforts, the continued growth in Arizona, combined with the high natural background ozone, will make achieving the eight-hour standard difficult.

Ultraviolet absorption instruments monitor ozone continuously in urban neighborhoods for population exposure, in areas downwind of urban areas for maximum concentration monitoring and in remote areas for background information. In 2000, 34 reporting ozone monitors were in operation; five for background, 22 for urban neighborhoods and 10 for maximum concentrations downwind of urban areas. Tables 8 and 9 present the ozone data collected in Arizona in 2000.

Table 8. 2000 Ozone Data (in ppm), One-Hour Averages					
Site or City	**Max Value**	**2nd High**	**3rd High**	**4th High**	**Valid Hourly Samples**
Cochise County					
Chiricahua National Monument	0.078	0.077	0.076	0.074	7,806
Coconino County					
Page	0.070	0.068	0.068	0.067	8,715
Grand Canyon Nat'l Park, Hance Camp	0.082	0.082	0.077	0.076	8,307
Maricopa County					
Blue Point	0.108	0.107	0.101	0.101	8,581
Cental Phoenix	0.094	0.092	0.091	0.091	8,579
Falcon Field [s]	0.097	0.093	0.092	0.090	5,084
Fountain Hills	0.117	0.106	0.101	0.097	8,514
Glendale [s]	0.100	0.094	0.090	0.089	5,620
Humboldt Mt., MCESD [s]	0.095	0.093	0.093	0.092	5,382
Lake Pleasant [s]	0.097	0.094	0.092	0.091	5,176
Maryvale [s]	0.100	0.096	0.093	0.092	5,171
Mesa	0.102	0.090	0.087	0.083	8,379
Mt. Ord	0.111	0.109	0.106	0.105	3,188
North Phoenix	0.107	0.107	0.098	0.096	8,525
Palo Verde	0.103	0.091	0.087	0.085	3,751
Phoenix, Emergency Management [s]	0.088	0.085	0.084	0.083	5,271
Phoenix, JLG Supersite # #	0.104	0.090	0.089	0.088	4,728
Pinnacle Peak	0.117	0.104	0.100	0.097	8,615
Rio Verde [s]	0.117	0.108	0.107	0.105	5,384

Table 8. 2000 Ozone Data (in ppm), One-Hour Averages					
Site or City	**Max Value**	**2nd High**	**3rd High**	**4th High**	**Valid Hourly Samples**
South Phoenix	0.102	0.094	0.093	0.092	8,542
South Scottsdale	0.099	0.097	0.097	0.096	8,620
Tempe, MCESD #	0.099	0.094	0.090	0.090	4,632
West Chandler [s] (Began 07/15/00)	0.100	0.099	0.091	0.090	3,580
West Phoenix	0.099	0.098	0.097	0.092	8,121
Pima County					
Saguaro NP East	0.087	0.083	0.081	0.080	8,247
Tucson, Children's Park	0.094	0.085	0.084	0.081	8,625
Tucson, Craycroft	0.089	0.084	0.084	0.084	8,742
Tucson, Downtown	0.077	0.076	0.075	0.074	8,210
Tucson, Fairgrounds	0.083	0.082	0.082	0.081	8,726
Tucson, Tangerine	0.081	0.078	0.077	0.077	8,715
Pinal County					
Apache Junction, Maintenance Yard	0.101	0.101	0.098	0.096	8,579
Casa Grande, Airport	0.105	0.094	0.090	0.089	8,262
Yavapai County					
Hillside	0.090	0.090	0.086	0.085	8,345
Yuma County					
Yuma	0.077	0.075	0.073	0.072	4,322

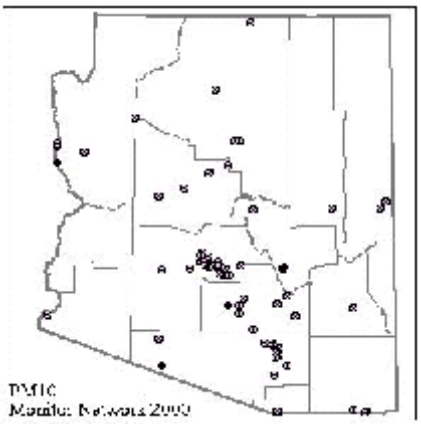
s – Seasonal monitoring
 # – Less than 75 percent data recovery in one or more calendar quarters for annual average
 # # – Less than 75 percent data recovery during ozone alert season, May 15-Oct. 15

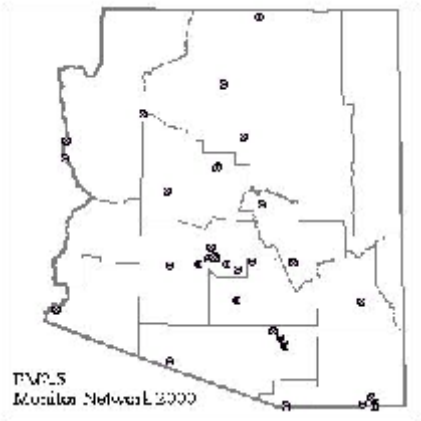
Table 9. 2000 Ozone Data (in ppm), Eight-Hour Averages						
Site or City	**Max Value**	**2nd High**	**3rd High**	**4th High**	**Daily Exceed.**	**Sample Days**
Cochise County						
Chiricahua Nat'l Monument	0.073	0.072	0.071	0.071	0	329
Coconino County						
Page	0.066	0.065	0.064	0.063	0	36
Grand Canyon Nat'l Park, Hance Camp	0.078	0.077	0.073	0.071	0	346
Maricopa County						
Blue Point	0.090	0.090	0.088	0.088	11	357
Cental Phoenix	0.088	0.081	0.077	0.077	1	357
Falcon Field [s]	0.083	0.080	0.077	0.075	0	212
Fountain Hills	0.089	0.089	0.089	0.085	4	355
Glendale [s]	0.088	0.082	0.082	0.081	1	234
Humboldt Mt., MCESD [s]	0.086	0.085	0.085	0.083	3	237
Lake Pleasant [s]	0.090	0.089	0.085	0.083	3	216
Maryvale [s]	0.091	0.081	0.081	0.081	1	215
Mesa	0.089	0.079	0.079	0.076	1	349
Mt. Ord	0.091	0.091	0.090	0.090	9	133
North Phoenix	0.092	0.087	0.087	0.087	4	355
Palo Verde	0.095	0.081	0.080	0.080	1	156
Phoenix, Emergency Management Station [s]	0.078	0.073	0.072	0.070	0	220
Phoenix, JLG Supersite # #	0.093	0.080	0.078	0.077	1	197
Pinnacle Peak	0.092	0.088	0.088	0.086	5	359

Table 9. 2000 Ozone Data (in ppm), Eight-Hour Averages						
Site or City	**Max Value**	**2nd High**	**3rd High**	**4th High**	**Daily Exceed.**	**Sample Days**
Rio Verde [s]	0.089	0.087	0.086	0.086	5	224
South Phoenix	0.087	0.086	0.085	0.084	3	356
South Scottsdale	0.087	0.083	0.081	0.080	1	359
Tempe, MCESD #	0.086	0.084	0.083	0.078	1	193
West Chandler [s] (Began 07/15/00)	0.089	0.080	0.080	0.078	1	149
West Phoenix	0.088	0.082	0.082	0.081	1	338
Pima County						
Saguaro NP East	0.076	0.075	0.074	0.074	0	344
Tucson, Children's Park	0.081	0.080	0.077	0.077	0	359
Tucson, Craycroft – PDEQ	0.079	0.078	0.076	0.075	0	364
Tucson, Downtown	0.073	0.070	0.068	0.067	0	342
Tucson, Fairgrounds	0.077	0.076	0.075	0.074	0	364
Tucson, Tangerine	0.074	0.074	0.074	0.073	0	363
Pinal County						
Apache Junction, Maint. Yard	0.087	0.084	0.082	0.082	1	358
Casa Grande, Airport	0.087	0.086	0.086	0.085	5	344
Yavapai County						
Hillside	0.087	0.084	0.083	0.083	1	348
Yuma County						
Yuma	0.068	0.068	0.067	0.061	0	180

s – Seasonal monitoring
 # – Less than 75 percent data recovery in one or more calendar quarters for annual average
 # # – Less than 75 percent data recovery during ozone alert season, May 15-Oct. 15

Particulate Matter Smaller Than 10 Microns (PM_{10}) and Smaller Than 2.5 Microns ($PM_{2.5}$)





Particulate matter is a collective term describing very small solid or liquid particles that vary considerably in size, geometry, chemical composition and physical properties. Produced by both natural processes (pollen and wind erosion) and human activity (soot, fly ash, dust from paved and unpaved roads), particulates contribute to visibility reduction, pose a threat to public health and cause economic damage through soil disturbance. Some fine particulates ($PM_{2.5}$) are formed by the condensation of vapors or by their subsequent growth through coagulation or agglomeration. Others are emitted directly from the sources, either by combustion or from mechanical grinding of soils. Coarse particulates (2.5 to 10 microns) are formed through mechanical processes such as the grinding of matter and the atomization of liquids. Fine particulates can also be classified as primary – produced within and emitted from a source with little subsequent change – or secondary – formed in the atmosphere from gaseous emissions. Secondary particulate nitrates and sulfates, for example, form in the atmosphere from the oxidation of sulfur dioxide and nitric oxide, which are two gases. In contrast, most atmospheric carbon is primary, having been emitted directly from combustion sources, although some of the organic carbon in the aerosol is secondary, having been formed by the complex photochemistry of gaseous volatile organic compounds.

The size, shape and chemical composition of particulates determine what health effects they will have. Particles larger than 10 microns are deposited in the upper respiratory tract. Particles from 2.5 to 10 microns are inhalable and are deposited in the upper parts of the respiratory system. Particles smaller than 2.5 microns are respirable and enter the pulmonary tissues to be deposited there. Particles in the size range of 0.1 to 2.5 microns are most efficiently deposited in the alveoli, where their effective toxicity is greater than larger particles because of the higher relative content of toxic heavy metals, sulfates and nitrates. Epidemiological studies have shown causal relationships between particulates and excess mortality, aggravation of bronchitis, and, in children, small, reversible changes in pulmonary function. Acidic aerosols have been linked to the inability of the upper respiratory tract and pulmonary system to remove harmful particles.

The Arizona Comparative Environmental Risk Project – a multi-disciplinary investigation into human exposure to all environmental risks completed in 1995– ranked outdoor air quality in general and particulate matter in particular as the highest environmental risk in the state. In this study, annual premature deaths from exposure to PM_{10} concentrations in Arizona were estimated at 963, including 667 in Maricopa County and 88 in Tucson. Increased percentages of hospital admissions for respiratory disease (1 to 4 percent, depending on the city), of asthma episodes (5 to 14 percent), of lower respiratory symptoms (5 to 15 percent), and of coughs (2 to 6 percent) were attributed to the prevailing (1991) annual PM_{10} concentrations. Chronically-high particulates concentrations in the ambient air continue to pose a serious health threat to many Arizonans.

Coarse particulate emissions are mostly geological and are dominated by dusts from three activities: re-entraining dust from paved roads, driving on unpaved roads and earthmoving associated with construction. Soil dust from these sources and others contribute more than 70 percent of the coarse particulates in Phoenix. On days with winds in excess of 15 miles per hour, wind erosion of soil contributes to this loading. With a more diverse chemical composition, fine particulates ($PM_{2.5}$) emissions are more evenly distributed among a larger number of sources. At the Phoenix JLG Supersite, receptor modeling indicates gasoline and diesel engine exhaust account for more than two thirds of the $PM_{2.5}$ emissions. Soil dust contributes another 10.5 percent. In other urban and rural areas, this mixture of sources will vary. Agricultural and mining areas, for example, will be more heavily influenced by emissions from these activities.

$PM_{2.5}$ concentrations tend to be at their highest in the central portions of urban areas, diminishing to background levels at the urban fringe. In contrast, PM_{10} concentrations are not smoothly spatially distributed, because each monitoring site is strongly influenced by the degree of localized emissions of coarse particulates. Background concentrations of PM_{10} are about 40 percent of the urban maxima (20 $\mu g/m^3$ for an annual average background versus about 50 $\mu g/m^3$ for the urban maximum). Background concentrations of $PM_{2.5}$ are about 5 $\mu g/m^3$, in contrast to the urban maxima of 12 to 15 $\mu g/m^3$. Concentrations of both size ranges of particulates tend to be higher in the late fall and winter, when atmospheric dispersion is at a seasonal low. PM_{10} maximum concentrations can occur in any season, provided nearby sources of coarse particulates are present or when strong and gusty winds suspend soil disturbed by human activities. Hourly concentrations of particulates tend to peak during those hours of the worst dispersion, which is from sunset to mid-morning.

Controls to reduce particulates have been in place for decades, beginning with an ordinance that required watering to reduce dust from construction in Pima County in the 1960s. Maricopa County's umbrella dust abatement rule, Rule 310, has been revised many times through the years and now regulates construction

dust, track-out dust from construction sites, and dust from unpaved parking and vacant lots. Efforts to reduce dust resuspended from paved roads have concentrated on eliminating track-out from construction sites, curbing and stabilizing road shoulders, and investigating more efficient street sweepers. Secondary fine particulates have been reduced by vehicular emission controls, which have reduced their precursor gases to fine particulates. Reducing gaseous hydrocarbon emissions has led to a significant reduction in the primary carbon emitted in motor vehicle exhaust. In Maricopa County, the Governor's Agricultural Best Management Practices Committee developed a rule containing best management practices for agricultural activities intended to reduce particulate emissions from tilling and harvesting activities of cropland and non-cropland. In a recent PM_{10} state implementation plan (SIP), the Maricopa Association of Governments committed to implement 77 new measures, including enhanced enforcement of the county dust rules, implementation of agricultural best management practices, diesel engine replacement and retirement programs, and requirements for cleaner burning fireplaces.

Particulates are monitored by pulling ambient air through a filter, generally for 24 hours every sixth day, weighing the filter before and after, and measuring the volume of air sampled. Prior to 1998, the concentrations were calculated using the information gathered and a standard temperature (25 ECelsius) and pressure (1 atmosphere). For 1998 and 1999, EPA required concentrations to be calculated using local (at the monitor) temperature and pressures. For 2000, the concentrations will revert to the standard temperature and pressure calculation.

The monitoring instruments are fitted with different aerodynamic devices to segregate particle size fractions. Particulates can also be monitored continuously with a tapered element oscillating microbalance (TEOM) instrument.

The 2000 PM_{10} data reported in Table 10 represent 73 monitors throughout Arizona and two in Mexico, located in Agua Prieta and Nogales, Sonora. Please note that TEOM data are not included in this table. Particulate data from the IMPROVE network were also not included because the complete data set for 2000 had not been processed. Both sets are available from ADEQ upon request.

EPA began a nationwide program to measure $PM_{2.5}$ using federal reference method monitors made to EPA specifications in anticipation of a new federal standard for fine particulates. In 1999 and 2000, 11 federal reference method samplers were located in Arizona. The fine particulate portion of the PM_{10} measurement made by dichot monitors has been measured for many years in Arizona and has served as an approximation for the $PM_{2.5}$ measurement. Table 11 lists both dichot fine and federal reference method measurements for 2000.

Table 10. 2000 PM_{10} Data (in Fg/m^3)					
Site or City	**Method**	**Annual Avg**	**24-Hour Avg**		**Valid Samples**
			Max Value	**2nd High**	
Apache County					
Springerville, Coalyard	Dichot	11.6	31	30	59
Springerville, Coyote Hills	Dichot	9.6	20	17	42
Cochise County					
Douglas, Red Cross	Dichot	37.9	104	90	55
Paul Spur	Partisol	22.9	58	57	59
Coconino County					
Flagstaff, ADOT	Partisol	15.3	38	32	59
Flagstaff, Middle School	Dichot	15.5	39	33	60
Page	Dichot	10.8	26	24	61
Sedona	Dichot	11.5	24	22	51
Gila County					
Hayden, Old Jail – ADEQ #	Dichot	33.6	86	65	54
Miami, Golf Course	Dichot	27.0	59	52	59
Miami, Ridgeline – ADEQ	Dichot	16.1	62	41	61
Payson	Partisol	24.6	88	59	58
Graham County					
Safford #	Dichot	26.9	94	69	42
Maricopa County					
Central Phoenix	Hi-Vol	46.3	135	105	59
Chandler	Hi-Vol	56.8	202	145	59
Estrella #	Dichot	32.2	82	77	44
Gilbert	Hi-Vol	49.1	128	109	60
Glendale	Hi-Vol	40.8	122	100	58

Table 10. 2000 PM_{10} Data (in Fg/m^3)					
Site or City	**Method**	**Annual Avg**	**24-Hour Avg**		**Valid Samples**
			Max Value	**2nd High**	
Higley, MCESD #	Hi-vol	67	327	143	38
Higley, ADEQ #	Dichot	57.9	136	129	53
Maryvale	Hi-Vol	47.7	173	109	61
Mesa	Hi-Vol	37.0	126	94	61
North Phoenix	Hi-Vol	37.1	114	114	59
Palo Verde	Dichot	20.6	75	43	57
Phoenix, ASU West	Dichot	32.1	101	84	59
Phoenix, Durango Complex	Hi-Vol	70.3	300	173	61
Phoenix, Greenwood – ADEQ #	Dichot	52.8	151	108	49
Phoenix, Greenwood – MCESD	Hi-Vol	61.1	164	159	60
Phoenix, JLG Supersite	Dichot	36.3	84	84	61
Phoenix, Salt River	Hi-Vol	101.0	244	232	54
South Phoenix	Hi-Vol	61.3	175	122	61
South Scottsdale	Hi-Vol	40.2	100	98	61
Tempe	Dichot	38.3	95	81	57
West Chandler	Hi-Vol	44.0	135	95	51
West Phoenix	Hi-Vol	52.5	151	133	59
Mohave County					
Bullhead City, ADEQ	Dichot	15.2	42	29	58
Bullhead City, SCE	Hi-Vol	29.0	79	55	51
Fort Mohave	Partisol	14.3	119	57	53
Kingman, Praxair NE #	Hi-Vol	15.0	55	39	52
Kingman, Praxair SW #	Hi-Vol	13.4	53	42	52

Table 10. 2000 PM_{10} Data (in Fg/m^3)					
Site or City	**Method**	**Annual Avg**	**24-Hour Avg**		**Valid Samples**
			Max Value	**2nd High**	
Navajo County					
Show Low #	Partisol	14.9	35	34	47
Pima County					
Ajo	Partisol	18.2	47	41	58
Green Valley	Hi-vol	16.7	63	35	60
Organ Pipe Cactus NM	Dichot	12.2	29	27	55
Rillito, ADEQ #	Partisol/ Dichot	42.1	129	102	43
Rillito, APCC	Hi-Vol	30.8	77	64	102
South Tucson, ADEQ	Dichot	28.0	59	55	58
South Tucson, PDEQ	Hi-Vol	38.4	142	123	358
Tucson, Broadway/Swan	Hi-Vol	30.0	119	56	58
Tucson, Corona de Tucson – ADEQ	Dichot	15.2	69	30	57
Tucson, Corona de Tucson – PDEQ	Hi-Vol	17.9	88	50	58
Tucson, Craycroft – ADEQ	Dichot	24.1	117	72	59
Tucson, Orange Grove – PDEQ	Hi-Vol	38.8	141	100	340
Tucson, Prince Road	Hi-vol	37.7	89	68	61
Tucson, Tangerine	Hi-Vol	18.4	71	38	59
Tucson, U of A Central – ADEQ	Teflon Dichot	26.2	75	69	56
Pinal County					
Apache Junction, North Maint. Yard	Hi-Vol	27.4	111	56	60
Apache Junction, South Maint. Yard	Hi-Vol	28.4	107	61	58
Casa Grande, Downtown	Hi-Vol	34.7	83	76	57

Table 10. 2000 PM_{10} Data (in Fg/m^3)					
Site or City	**Method**	**Annual Avg**	**24-Hour Avg**		**Valid Samples**
			Max Value	**2nd High**	
Casa Grande, Eleven Mile Corner – Fairgrounds	Hi-Vol	67.5	321	263	58
Coolidge, Maintenance Yard	Hi-Vol	37.4	77	74	58
Eloy City Complex, ELY	Hi-Vol	41.7	102	92	60
Mammoth County Complex	Hi-Vol	22.0	64	61	58
Pinal Air Park	Hi-Vol	30.9	74	57	58
Stanfield	Hi-Vol	45.7	149	114	57
Santa Cruz County					
Nogales, Post Office	Dichot	47.6	130	116	58
Yavapai County					
Clarkdale, ADEQ	Dichot	15.8	37	34	53
Clarkdale, NW of Cement Plant (#2)	Dichot	22.9	55	54	61
Clarkdale, SE of CTI Flyash Silo (#1)	Dichot	29.6	74	48	61
Hillside #	Dichot	9.9	30	25	46
Nelson #	Dichot	13.6	32	27	50
Prescott	Partisol	11.8	25	21	42
Yuma County					
Yuma, Juvenile Center #	Dichot	42.3	132	99	43
Mexico					
Agua Prieta, Fire Station	Dichot	81.3	186	164	58
Nogales, Fire Station	Dichot	76.9	189	170	58

 # – Less than 75 percent data recovery in one or more calendar quarters.

Table 11. 2000 PM $_{2.5}$ Data (in µg/m^3)					
City or Site	**Method**	**Annual Avg**	**24-Hour Avg**		**Valid Samples**
			Max	**2nd High**	
Cochise County					
Douglas, Cemetery	Dichot	N/A	33.7	30.7	15
Douglas, Red Cross	Dichot	7.1	16.1	12.4	55
Douglas, Red Cross	FRM	8.9	48	38.5	57
Coconino County					
Flagstaff, Middle School	Dichot	4.7	16.8	12.4	60
Flagstaff, Middle School	FRM	6.9	26.3	24.5	56
Page	Dichot	4.4	12.9	10.4	61
Sedona	Dichot	3.9	7.8	7.6	51
Gila County					
Hayden, Old Jail – ADEQ #	Dichot	9.2	26.5	18.7	54
Miami, Golf Course	Dichot	6.1	12.1	11.8	59
Miami, Ridgeline – PDMI	Dichot	4.4	10.5	10.3	61
Payson	FRM	10.0	28.0	27.3	86
Graham County					
Safford #	Dichot	5.6	12	8.9	42
Maricopa					
Estrella #	Dichot	7.7	23.4	21.9	44
Higley, ADEQ #	Dichot	10.0	29.7	25.8	53
Palo Verde	Dichot	4.9	11.0	10.5	57
Phoenix, ASU West	Dichot	8.5	24.1	17.1	59
Phoenix, Desert West Rec. Center	FRM	12.1	54.1	37.4	326
Phoenix, Greenwood – ADEQ #	Dichot	16.3	114.2	86.9	49
Phoenix, Magnet (Closed 06/09/00) #	FRM	N/A	37.6	30.8	127

Table 11. 2000 PM $_{2.5}$ Data (in µg/m^3)					
City or Site	**Method**	**Annual Avg**	**24-Hour Avg**		**Valid Samples**
			Max	**2nd High**	
Phoenix, JLG Super Site	Dichot	10.4	30.6	25.2	61
Phoenix, JLG Super Site	FRM	11.5	38.2	33.2	296
Tempe, ADEQ	Dichot	10.0	24.1	20.5	57
Tempe, ADEQ	FRM	10.3	32.9	20.1	115
Mohave County					
Bullhead City, ADEQ	Dichot	4.7	8.5	8.3	58
Pima County					
Organ Pipe Cactus, NM	Dichot	4.2	7.7	7.3	55
Rillito, ADEQ #	Dichot	8.8	29.4	15.2	43
South Tucson, ADEQ	Dichot	7.3	13.4	12.5	58
Tucson, Children's Park #	FRM	6.5	13.6	11.1	106
Tucson, Corona de Tucson – ADEQ	Dichot	4.7	12.1	11.3	57
Tucson, Craycroft – ADEQ	Dichot	16.7	78	50.7	59
Tucson, Orange Grove – PDEQ #	FRM	7.6	13.3	12.8	96
Tucson, U of A Central – ADEQ	Dichot	7.8	55.2	13	56
Pinal County					
Apache Junction, Fire Station	FRM	7.2	44.4	27.1	120
Casa Grande, Downtown	FRM	8.4	22.2	18.8	59
Santa Cruz County					
Nogales, Post Office	Dichot	12.8	37.7	34.6	58
Nogales, Post Office	FRM	12.8	36	34.4	53
Yavapai County					
Clarkdale, ADEQ	Dichot	4.1	7.2	5.5	53
Clarkdale, NW of Cement Plant (#2)	Dichot	5.9	21.5	14.4	61

Table 11. 2000 PM $_{2.5}$ Data (in µg/m^3)					
City or Site	**Method**	**Annual Avg**	**24-Hour Avg**		**Valid Samples**
			Max	**2nd High**	
Clarkdale, SE of CTI Flyash Silo (#1)	Dichot	6.4	18.3	115.7	61
Hillside #	Dichot	3.2	8.8	5.9	46
Nelson	Dichot	3.8	9.0	6.8	50
Prescott #	Partisol/ Dichot	3.7	13.3	10.3	32
Yuma County					
Yuma, Juvenile Center #	Dichot	9.8	46.1	24.2	43
Mexico					
Agua Prieta, Fire Station	Dichot	20.5	56.6	54.1	58
Nogales, Fire Station	Dichot	15.5	52.8	46.2	58

 # – Less than 75 percent data recovery in one or more calendar quarters.
N/A – Not available

Conventional Pollutants – Compliance

Carbon Monoxide

There are two national ambient air quality standards for carbon monoxide: an eight-hour standard (most critical for compliance) and a one-hour standard. The eight-hour standard is 9 ppm and the one-hour standard is 35 ppm. According to the Code of Federal Regulations, compliance for both standards is determined by having no more than one exceedance per calendar year. EPA determines attainment of the standard at all sites in the non-attainment (or monitoring) area by evaluating two calendar years of data from each site. The highest of the second-highest values for the two-year period must not exceed the standard of 9 ppm (greater than or equal to 9.5 ppm to adjust for rounding) for the eight-hour standard or 35 ppm (greater than or equal to 35.5 ppm) for the one-hour standard.

No exceedances of the one-hour standard were recorded in 1999. The eight-hour standard was exceeded on Nov. 30, 1999 at the ADEQ Grand Avenue monitor in Phoenix. Because this was the only exceedance at this monitor during the 1999-2000 period, no violation of the standard occurred and the monitor is currently in compliance. These data are presented in Table 12 and Table 13.

Table 12. 1999-2000 One-Hour Carbon Monoxide Compliance (in ppm)

National ambient air quality standard for one-hour carbon monoxide: The second-highest value for the two-year period must not exceed 35 ppm

1999-2000 One-Hour Carbon Monoxide National Ambient Air Quality Standard Compliance Values by County

	Exceedance	Violations
Maricopa	0	0
Pima	0	0
Pinal	0	0

Summary: 20 of 20 monitors in compliance

Table 12. 1999-2000 One-Hour Carbon Monoxide Compliance (in ppm)

City or Site	1999		2000		Compliance Value
	Max	2nd High	Max	2nd High	
Maricopa County					
Central Phoenix	11.3	9.3	8.1	8.0	9.3
Gilbert [s]	3.8	3.7	3.7	3.3	3.7
Glendale [s]	5.7	5.3	4.6	4.6	5.3

Table 12. 1999-2000 One-Hour Carbon Monoxide Compliance (in ppm)					
City or Site	**1999**		**2000**		**Compliance Value**
	Max	**2nd High**	**Max**	**2nd High**	
Maryvale [s]	9.7	9.0	9.3	9.1	9.3
Mesa [s]	7.2	5.8	6.0	5.1	6.0
North Phoenix [s]	7.8	6.3	6.0	5.9	6.3
Phoenix, Grand Avenue [s]	18.4	13.4	10.5	10.5	13.4
Phoenix, Greenwood – MCESD	10.8	9.5	8.1	8.1	9.5
Phoenix, JLG Supersite	8.5	8.2	9.1	7.9	8.5
Phoenix, West Indian School	11.8	11.7	11.9	8.9	11.8
South Phoenix [s]	7.8	7.7	10.0	8.4	8.4
South Scottsdale [s]	6.0	5.8	5.0	4.9	5.8
Tempe, MCESD	N/A	N/A	5.0	4.6	N/A
West Chandler [s]	4.3	4.0	5.7	3.8	4.0
West Phoenix	12.3	11.9	10.6	10.4	11.9
Pima County					
Tucson, Alvernon	8.5	7.8	8.9	7.5	8.5
Tucson, Cherry	5.2	5.2	5.3	5.0	5.2
Tucson, Craycroft – PDEQ	5.4	4.7	5.4	5.4	5.4
Tucson, Downtown	10.6	6.3	6.7	6.0	6.7
Pinal County					
Apache Junction, Maintenance Yard	1.9	1.7	1.4	1.3	1.7
Casa Grande, Airport	2.1	1.5	2.4	2.2	2.2

s – Seasonal monitor
 # – Less than 75 percent data recovery in one or more calendar quarters
N/A – Not available

Table 13. 1999-2000 Eight-Hour Carbon Monoxide Compliance (in ppm)

National ambient air quality standard for eight-hour carbon monoxide: The second-highest value for the two-year period must not exceed 9 ppm

1999-2000 Eight-Hour Carbon Monoxide National Ambient Air Quality Standard Compliance Values by County

	Exceedance	Violations
Maricopa	0	0
Pima	0	0
Pinal	0	0

Summary: 20 of 20 monitors in compliance

Table 13. 1999-2000 Eight-Hour Carbon Monoxide Compliance (in ppm)

City or Site	1999		2000		Compliance Value
	Max	2nd High	Max	2nd High	
Maricopa County					
Central Phoenix	7.2	5.9	5.3	5.0	5.9
Gilbert [s]	2.4	2.4	2.0	2.0	2.4
Glendale [s]	3.8	3.4	3.5	3.2	3.5
Maryvale [s]	7.2	6.6	7.0	7.0	7.0
Mesa [s]	4.4	4.0	4.3	3.4	4.3
North Phoenix [s]	3.5	3.5	3.1	3.1	3.5
Phoenix, Grand Avenue [s]	10.5	8.0	6.0	6.0	8.0
Phoenix, Greenwood – MCESD	6.7	6.6	5.6	5.6	6.6
Phoenix, JLG Supersite	7.0	6.6	6.9	6.4	6.6
Phoenix, West Indian School Road	7.6	7.5	6.8	6.7	7.5
South Phoenix [s]	4.6	4.4	5.9	4.7	4.7
South Scottsdale [s]	4.3	4.1	3.3	3.1	4.1
Tempe, MCESD	N/A	N/A	3.7	3.5	N/A
West Chandler [s]	2.9	2.8	2.5	2.3	2.8
West Phoenix	7.7	7.4	7.4	7.2	7.4

Table 13. 1999-2000 Eight-Hour Carbon Monoxide Compliance (in ppm)					
City or Site	**1999**		**2000**		**Compliance Value**
	Max	**2nd High**	**Max**	**2nd High**	
Pima County					
Tucson,- Alvernon	4.2	3.8	5.0	4.7	4.7
Tucson, Cherry	3.4	3.4	3.7	3.3	3.4
Tucson, Craycroft – PDEQ	2.3	2.0	2.7	2.4	2.4
Tucson, Downtown	4.3	3.2	3.8	3.5	3.8
Pinal County					
Apache Junction, Maintenance Yard	0.9	0.8	0.6	0.6	0.8
Casa Grande, Airport	0.8	0.8	0.9	0.8	0.8

s – Seasonal monitor
 # – Less than 75 percent data recovery in one or more calendar quarters
N/A – Not available

Lead

In 2000, the national ambient air quality standards for lead, 1.5 micrograms per cubic meter (Fg/m^3) averaged for a calendar quarter, was not exceeded at any Arizona monitor.

Table 14. 2000 Lead Quarterly Average National Ambient Air Quality Standard Compliance Values, By County

	Exceedances	Violations
Apache	0	0
Cochise	0	0
Coconino	0	0
Gila	0	0
Maricopa	0	0
Pima	0	0
Pinal	0	0
Santa Cruz	0	0
Yavapai	0	0
Summary: 16 of 16 monitors in compliance		

Nitrogen Dioxide

The national ambient air quality standards for nitrogen dioxide is 0.053 parts per million for an annual average. The standard is attained when the annual arithmetic mean concentration in a calendar year is less than or equal to 0.053 ppm. To demonstrate attainment, the annual mean must be based upon hourly data that are at least 75 percent complete. The 2000 nitrogen dioxide annual averages near Arizona power plants ranged from 2 percent to 17 percent of the standard; in the urban areas, 30 percent to 70 percent. All Arizona sites were in compliance with the national ambient air quality standards. Refer to Table 6 for the 2000 averages.

Table 15. 2000 Nitrogen Dioxide Average National Ambient Air Quality Standard Compliance Values, By County

	Exceedance	Violations
Apache	0	0
Maricopa	0	0
Mohave	0	0
Pima	0	0
Summary: 16 of 16 monitors in compliance		

Sulfur Dioxide

There are three national ambient air quality standards for sulfur dioxide, two primary (annual average and 24-hour block average) and one secondary (three-hour block average). The annual average standard is 80 Fg/m^3 (approximately 0.03 ppm) and the maximum 24-hour block average standard is 365 Fg/m^3 (approximately 0.14 ppm). To demonstrate attainment, neither standard can be exceeded in a calendar year. In addition, the averages must be based upon hourly data that are 75 percent complete. A 24-hour block average is considered valid if at least 75 percent of the hourly averages for the 24-hour period are available. The 24-hour averages are determined from successive non-overlapping 24-hour blocks which begin at midnight each day.

The secondary three-hour standard is 1300 Fg/m^3 (approximately 0.50 ppm) and is not to be exceeded more than once per calendar year. The three-hour averages are determined from successive nonoverlapping three-hour blocks starting at midnight each calendar day.

In Arizona, the maximum concentration sites – all near copper smelters – comply with these standards; the concentrations being no higher than 66 percent of the three-hour, 78 percent of the 24-hour, and 51 percent of the annual average standards. Sites near power plants are close to background levels, with annual averages from less than 1 to 8 Fg/m^3. Refer to Table 7 for the 2000 averages.

Table 16. 2000 Sulfur Dioxide Average National Ambient Air Quality Standard Compliance Values, By County

County	Annual		Three Hour		24-Hour	
	Exceedances	Violations	Exceedances	Violations	Exceedances	Violations
Apache	0	0	0	0	0	0
Gila	0	0	0	0	0	0
Maricopa	0	0	0	0	0	0
Mohave	0	0	0	0	0	0
Pima	0	0	0	0	0	0
Pinal	0	0	0	0	0	0
Summary: 15 out of 15 monitors in compliance						

Ozone

The national ambient air quality standards include a standard for one-hour ozone and a proposed standard for eight-hour ozone. The one-hour standard is 0.12 ppm. Compliance with this standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm (0.124 ppm for rounding) is equal to or less than one. A daily exceedance is defined as any day having one or more hourly averages equal to or greater than 0.125 ppm. Hourly averages for at least 75 percent of the hours sampled (18-24 hours per day) must be present. The most recent three calendar years of daily averages are used to determine if the annual standard is met.

No exceedances of the one hour standard occurred in Arizona in 2000. The last exceedance of the one-hour standard occurred in 1996 in Phoenix.

EPA developed the proposed eight-hour ozone standards in response to human exposure studies that showed adverse health effects occur at lower ozone concentrations extending over several hours. The new ozone standard was proposed in 1997, but was subsequently the subject of a lawsuit. The U.S. Supreme Court has upheld EPA's decision that an eight-hour standard is viable, but remanded the case to EPA to further determine what the final standard should be. Monitoring agencies continue to record monitoring data to gather information on occurrence and ability for future compliance with an eight-hour standard.

The proposed eight-hour ozone standard is 0.08 ppm (0.84 for rounding) for a daily maximum eight-hour average. This standard is met when the average of the annual fourth-highest daily maximum eight-hour average ozone concentration is less than or equal to 0.08 ppm. The most recent three calendar years are used to assess compliance with the standard.

Table 17. 1998-2000 Eight-Hour Ozone Compliance (in ppm)

Proposed national ambient air quality standards: The average of the annual fourth-highest daily maximum eight-hour average ozone concentration is less than or equal to 0.08 ppm

1999-2000 Eight-Hour Carbon Monoxide National Ambient Air Quality Standard Compliance Values, by County

	Eight-Hour Exceedances			Sites in Violation
	1998	1999	2000	
Cochise	0	0	0	0
Coconino	0	0	0	0
Maricopa	84	62	57	6
Pima		3	6	0
Pinal	2	2	6	0
Yavapai	3	3	1	0
Yuma	2	1	0	0

Summary: 27 of 33 monitors in compliance for 1998-2000

Table 17. 1998-2000 Eight-Hour Ozone Compliance (in ppm)

City or Site	Fourth-Highest Value			Three-Year Avg
	1998	1999	2000	
Cochise County				
Chiricahua National Monument	0.068	0.072	0.071	0.070
Coconino County				
Page	0.065	0.065	0.063	0.064
Grand Canyon National Park, Hance Camp	0.073	0.077	0.071	0.073
Maricopa County				
Blue Point	0.089	0.087	0.088	0.088
Central Phoenix	0.079	0.078	0.077	0.078
Falcon Field [s]	0.083	0.082	0.075	0.080
Fountain Hills	0.086	0.086	0.085	0.085
Glendale [s]	0.070	0.083	0.081	0.078
Humboldt Mt., MCESD [s]	0.090	0.088	0.083	0.087
Lake Pleasant [s]	0.082	0.081	0.083	0.082
Maryvale [s]	0.087	0.080	0.081	0.082

Table 17. 1998-2000 Eight-Hour Ozone Compliance (in ppm)				
City or Site	**Fourth-Highest Value**			**Three-Year Avg**
	1998	**1999**	**2000**	
Mesa	0.080	0.084	0.076	0.080
Mt. Ord [s]	0.089	0.088	0.090	0.089
North Phoenix	0.089	0.084	0.087	0.086
Palo Verde	0.080	0.080	0.080	0.080
Phoenix, Emergency Management [s]	0.081	0.087	0.070	0.079
Phoenix, JLG Supersite # #	0.079	0.061	0.077	0.072
Pinnacle Peak	0.086	0.085	0.086	0.085
Rio Verde	N/A	0.085	0.086	N/A
South Phoenix	0.081	0.075	0.084	0.080
South Scottsdale	0.079	0.072	0.080	0.077
West Chandler (Began 07/15/00) [s]	0.075	0.069	0.078	0.073
West Phoenix	0.086	0.091	0.081	0.086
Pima County				
Saguaro NP East	0.076	0.071	0.074	0.074
Tucson, Children's Park	0.072	0.072	0.077	0.073
Tucson, Craycroft – PDEQ	0.073	0.071	0.075	0.073
Tucson, Downtown	0.062	0.064	0.067	0.064
Tucson, Fairgrounds	0.071	0.068	0.074	0.071
Tucson, Tangerine	0.070	0.073	0.073	0.072
Pinal County				
Apache Junction, Maintenance Yard	0.082	0.080	0.082	0.081
Casa Grand, Airport	0.068	0.078	0.085	0.077
Yavapai County				
Hillside	0.083	0.084	0.083	0.083

Table 17. 1998-2000 Eight-Hour Ozone Compliance (in ppm)				
City or Site	**Fourth-Highest Value**			**Three-Year Avg**
	1998	**1999**	**2000**	
Yuma County				
Yuma	0.089	0.079	0.061	0.076

s – Seasonal monitor
 # – Less than 75 percent data recovery for the year
N/A – Not available
 # # – Less than 75 percent data recovery during ozone alert season, May 15-Oct. 15

Particulate Matter – PM_{10}

With the delay in adopting the proposed $PM_{2.5}$ standards, 2000 compliance will be assessed using the rules in place prior to the 1997 proposal. Therefore, the national ambient air quality standards for particulate matter 10 microns and less in diameter (PM_{10}) are 50 Fg/m^3 for the annual arithmetic mean concentration and 150 Fg/m^3 for the 24-hour average concentration. The annual standard is met when the three-year average of the annual means is less than or equal to 50Fg/m^3. The annual average is determined by calculating quarterly (three month) averages of the samples collected during that quarter; a minimum of 75 percent of the samples must be present to produce a valid annual average. The four quarterly averages are used to produce the annual average. Compliance with the 24-hour PM_{10} standard is attained when the expected exceedance rate of occurrence of samples greater than or equal to 150 Fg/m^3 is one or less per year measured over three years. The same requirements of 75 percent completeness and three consecutive years of data apply. Tables 15 and 16 present the 1998-2000 data.

Table 18. 1998-2000 Annual Average PM_{10} Compliance (in µg/m^3)

National ambient air quality standards: The three-year average of annual averages is less than or equal to 50 Fg/m^3

1999-2000 PM_{10} Annual Average National Ambient Air Quality Standard Compliance Values, by County

	Sites with Exceedances			Sites in Violation
	1998	1999	2000	
Apache	0	0	0	0
Cochise	0	0	0	0
Coconino	0	0	0	0
Gila	0	0	0	0
Maricopa	2	3	7	3
Mohave	0	0	0	0
Navajo	0	0	0	0
Pima	0	0	0	0
Pinal	1	1	1	1
Santa Cruz	0	1	1	0
Yavapai	0	0	0	0
Yuma	0	0	0	0

Summary: 65 of 69 monitors in compliance for 1998-2000

Table 18. 1998-2000 Annual Average PM_{10} Compliance (in µg/m^3)

City or Site	1998	1999	2000	Three-Year Avg
Apache County				
Springerville, Coalyard	9.0	11.3	11.6	11
Springerville, Coyote Hills	8.0	8.1	9.6 #	9
Cochise County				
Douglas, Red Cross	30.5 # #	35.2 #	37.9	35
Paul Spur	42.2	29.3	22.9	30
Coconino County				
Flagstaff, ADOT	12.1	18.0 #	15.3	15
Flagstaff, Middle School	12.6	14.0	15.5	14
Sedona	10.4	N/A	10.8	N/A
Gila County				
Hayden, Old Jail	29.4	35.3	33.6 #	33

Table 18. 1998-2000 Annual Average PM_{10} Compliance (in $\mu g/m^3$)				
City or Site	**1998**	**1999**	**2000**	**Three-Year Avg**
Miami, Golf Course	23.0	22.0	27.0	24
Miami, Ridgeline – PDMI	11.0	13.0	16.1	13
Payson	21.4	20.7	24.6	22
Graham County				
Safford	26.3	N/A	26.9 #	N/A
Maricopa County				
Central Phoenix	N/A	43.6 #	46.3	N/A
Chandler	45.0	59.6	56.8	54
Estrella	24.6	34.4	32.2 #	30
Gilbert	42.0	45.4	49.1	46
Glendale	29.0	36.3	40.8	35
Higley, ADEQ	50.2	61.2	57.9 #	56
Maryvale	36.0	44.7	47.7	43
Mesa	29.0	35.3	37.0	34
North Phoenix	29.0	34.5	37.1	34
Palo Verde	18.9	21.7	20.6	20
Phoenix, ASU West	25.2	30.7	32.1	29
Phoenix, Greenwood – ADEQ	43.1	53.1	52.8 #	50
Phoenix, Greenwood – MCESD	50.0	55.8	61.1	56
Phoenix, JLG Supersite	31.4 #	35.1	36.3	34
Phoenix, Salt River	N/A	101.0	101.0	N/A
South Phoenix	N/A	N/A	61.3	N/A
South Scottsdale	34.0	40.1	40.2	38
Tempe	30.6	36.0	38.3	35
West Chandler	34.0	48.2	44.0	42

Table 18. 1998-2000 Annual Average PM_{10} Compliance (in µg/m^3)				
City or Site	**1998**	**1999**	**2000**	**Three-Year Avg**
West Phoenix	39.0	51.3	52.5	48
Mohave County				
Bullhead City, ADEQ	9.8	12.9	15.3	13
Bullhead City, SCE	22.0	29.5	29.0	27
Fort Mohave	12.0	12.3 #	14.3	13
Kingman, Praxair NE	N/A	15.4	15.0 #	N/A
Kingman, Praxair SW	N/A	15.6	13.4	N/A
Navajo County				
Show Low	N/A	16.2 #	14.9	N/A
Pima County				
Ajo	N/A	21.7	18.5	N/A
Green Valley, PDEQ	14.0	17.9	16.7	16
Organ Pipe Cactus National Monument	8.0	10.0 #	12.2	10
Rillito, ADEQ	N/A	35.8 #	42.1 #	35
Rillito, APCC	30.0	30.7	30.8	31
South Tucson, ADEQ	N/A	N/A	28.0	N/A
South Tucson, PDEQ	36.0	48.4	38.4	41
Tucson, Broadway and Swan	24.0	31.6	30.0	29
Tucson, Corona de Tucson – ADEQ	N/A	N/A	15.2	N/A
Tucson, Corona de Tucson – PDEQ	14.0	18.4	17.9	17
Tucson, Craycroft – ADEQ	21.0	26.0	24.1	24
Tucson, Orange Grove – PDEQ	24.0	45.8	38.8	36
Tucson, Prince Road	33.0	43.7	37.7	38
Tucson, Tangerine	12.0	18.4	18.4	16

Table 18. 1998-2000 Annual Average PM_{10} Compliance (in µg/m^3)				
City or Site	**1998**	**1999**	**2000**	**Three-Year Avg**
Tucson, U of A Central – ADEQ	23.0	26.0	26.2	25
Pinal County				
Apache Junction, North Maintenance Yard	24.6	25.8	27.4	26
Apache Junction, South Maintenance Yard	25.6	27.5	28.4	27
Casa Grande, Downtown	30.6 #	35.3	34.7	34
Casa Grande, Eleven Mile Corner – Fairgrounds	52.2	71.0	67.5	64
Coolidge	37.2	39.6	37.4	38
Eloy	43.7 #	45.9	41.7	44
Mammoth	21.8	22.5	22.0	22
Pinal Air Park	27.1 #	30.3	30.9	29
Stanfield	41.3	56.6	45.7	48
Santa Cruz County				
Nogales, Post Office	39.9	52.5 #	47.6	47
Yavapai County				
Clarkdale, ADEQ	14.5	15.3	15.8	15
Clarkdale, NW of Cement Plant (#2)	19	22.6	22.9	22
Clarkdale, SE of CTI Flyash Silo (#1)	25	28.1	29.6	28
Hillside	11.5	7.5 #	9.9 #	10
Nelson	10.2	12.4	13.6 #	12
Prescott	N/A	N/A	11.8	N/A
Yuma County				
Yuma, Juvenile Center	40.3	35.2 #	42.2 #	39

Table 18. 1998-2000 Annual Average PM_{10} Compliance (in µg/m^3)				
City or Site	**1998**	**1999**	**2000**	**Three-Year Avg**
Mexico				
Agua Prieta, Fire Station	N/A	63.0	81.3	N/A
Nogales, Fire Station	N/A	59.8	76.9	N/A

 # – Annual average based on less than 75 percent data recovery per one or more quarters
 # # – Data from two locations in Douglas
N/A – Data not available or annual average not able to be calculated due to insufficient data

Table 19 1998-2000 Maximum 24-Hour Average PM_{10} Compliance (in Fg/m^3)

National ambient air quality standards: Expected occurrence of exceedances (samples equal to or greater than 150 ug/m3) is one or less over three consecutive years

1998-2000 PM_{10} Maximum 24-Hour Compliance Values, by County

	Sites with Exceedances			Sites in Violation
	1998	1999	2000	
Apache	0	0	0	0
Cochise	0	0	0	0
Coconino	0	0	0	0
Gila	0	0	0	0
Maricopa	4	11	14	7
Mohave	0	0	0	0
Navajo	0	0	0	0
Pima	0	0	0	0
Pinal	1	3	2	1
Santa Cruz	2	2	0	1
Yavapai	0	0	0	0
Yuma	0	0	0	0

Summary: 60 of 69 monitors in compliance for 1998-2000

Table 19. 1998-2000 Maximum 24-Hour Average PM_{10} Compliance (in Fg/m^3)

City or Site	1998		1999		2000		Expected Exceed. Rate
	Max	No.	Max	No.	Max	No.	
Apache County							
Springerville, Coalyard	26	0	49	0	31	0	0
Springerville, Coyote Hills	25	0	25	0	20 #	0	0
Cochise County							
Douglas, Red Cross	105	0	83 #	0	104	0	0
Paul Spur	82	0	78	0	58	0	0
Coconino County							
Flagstaff, ADOT	33	0	62 #	0	38	0	0
Flagstaff, Middle School	30	0	35	0	39	0	0
Page	N/A	0	20	0	26	0	0
Sedona	54	0	17	0	24	0	0

Table 19. 1998-2000 Maximum 24-Hour Average PM_{10} Compliance (in Fg/m^3)							
City or Site	**1998**		**1999**		**2000**		**Expected Exceed. Rate**
	Max	**No.**	**Max**	**No.**	**Max**	**No.**	
Gila County							
Hayden, Old Jail	78	0	84	0	86 #	0	0
Miami, Golf Course	51	0	43	0	59	0	0
Miami, Ridgeline	27	0	34	0	62	0	0
Payson	69	0	47 #	0	88	0	0
Graham County							
Safford	98	0	125 #	0	94 #	0	0
Maricopa County							
ASU West	55	0	55	0	101	0	0
Central Phoenix	70	0	85 #	0	135	0	0
Chandler	136	0	110	0	202	0	0
Estrella	56	0	80	0	82 #	0	0
Gilbert	133	0	90	0	128	0	0
Glendale	61	0	77	0	122	0	0
Higley, ADEQ	135	0	208	1	136 #	0	< 1
Maryvale	92	0	104	0	173	1	< 1
Mesa	64	0	80	0	126	0	0
North Phoenix	67	0	70	0	114	0	0
Palo Verde	47	0	83	0	75	0	0
Phoenix, Durango Complex	N/A	N/A	N/A	N/A	**300**	2	N/A
Phoenix, Greenwood (ADEQ)	106	0	111	0	151 #	1	< 1
Phoenix, Greenwood (MCESD)	121	0	117	0	164	2	< 1
Phoenix, JLG Super Site	69	0	78	0	84	0	0

Table 19. 1998-2000 Maximum 24-Hour Average PM_{10} Compliance (in Fg/m^3)							
City or Site	**1998**		**1999**		**2000**		**Expected Exceed. Rate**
	Max	**No.**	**Max**	**No.**	**Max**	**No.**	
Phoenix, Salt River	403	4	256	9	244	6	6
South Phoenix	77	0	126	0	175	1	< 1
South Scottsdale	82	0	87	0	100	0	0
Tempe, ADEQ	70	0	82	0	95	0	0
West Chandler	85	0	151	1	135	0	< 1
West Phoenix	108	0	111	0	151	1	< 1
Mohave County							
Bullhead City, SCE	76	0	122	0	79	0	0
Bullhead City, ADEQ	27	0	26	0	42	0	0
Fort Mohave	39	0	30 #	0	119	0	0
Kingman, Praxair NE #1	N/A	0	44	0	55 #	0	0
Kingman, Praxair SW #2	N/A	0	46	0	53 #	0	0
Navajo County							
Show Low	27	0	38 #	0	35 #	0	0
Pima County							
Ajo	65	0	41	0	47	0	0
Green Valley, PDEQ	32	0	38	0	63	0	0
Organ Pipe Cactus, NM	22	0	18 #	0	29	0	0
Rillito, ADEQ	74	0	98 #	0	129 #	0	0
Rillito, APCC	79	0	123	0	77	0	0
South Tucson, PDEQ	79	0	214	2 # #	142	0	0
Tucson, Broadway/Swan	49	0	89	0	119	0	0
Tucson, Corona de Tucson – PDEQ	41	0	51	0	88	0	0

Table 19. 1998-2000 Maximum 24-Hour Average PM_{10} Compliance (in Fg/m^3)							
City or Site	**1998**		**1999**		**2000**		**Expected Exceed. Rate**
	Max	**No.**	**Max**	**No.**	**Max**	**No.**	
Tucson, Craycroft – ADEQ	51	0	55	0	117	0	0
Tucson, Orange Grove – PDEQ	44	0	235	4 # #	141	0	0
Tucson, Prince Road	83	0	118	0	89	0	0
Tucson, Tangerine	29	0	41	0	71	0	0
Tucson, U of A Central – ADEQ	48	0	54	0	75	0	0
Pinal County							
Apache Junction, North Maintenance Yard	61	0	64	0	111	0	0
Apache Junction, South Maintenance Yard	63	0	64	0	107	0	0
Casa Grande, Downtown	76 #	0	64	0	83	0	0
Casa Grande, Eleven Mile Corner – Fairgrounds	162	1	368	3	321	2	2
Coolidge	144	0	83	0	77	0	0
Eloy	111 #	0	142	0	102	0	0
Mammoth	49	0	50	0	64	0	0
Marana, Pinal Air Park	67	0	60	0	74	0	0
Stanfield	113	0	106	0	149	0	0
Santa Cruz County							
Nogales, Post Office	155	1	169 #	2	130	0	1
Yavapai County							
Clarkdale, ADEQ	26	0	30	0	37	0	0
Clarkdale, NW of Cement Plant (#2)	82	0	48	0	55	0	0

Table 19. 1998-2000 Maximum 24-Hour Average PM_{10} Compliance (in Fg/m^3)							
City or Site	**1998**		**1999**		**2000**		**Expected Exceed. Rate**
	Max	**No.**	**Max**	**No.**	**Max**	**No.**	
Clarkdale, SE of CTI Flyash Silo (#1)	51	0	53	0	74	0	0
Hillside	20	0	22 #	0	30 #	0	0
Nelson	53	0	32	0	32 #	0	0
Prescott	N/A	N/A	N/A	N/A	25	0	N/A
Yuma County							
Yuma Juvenile Center	109	0	102	0	132 #	0	0

 # – Less than 75 percent data recovery per one or more quarters.

 # # – Exceedances at the Orange Grove and South Tucson sites in Pima County in 1999 are flagged as due to natural events and are excluded from the compliance calculation.

N/A – Not Available

Particulate Matter – $PM_{2.5}$

The proposed national ambient air quality standards for particulate matter 2.5 microns and smaller in diameter ($PM_{2.5}$) are under review due to litigation at the federal level. These standards will still be used to assess the compliance of the monitors operating in Arizona during 2000. The standards are 15.0 micrograms per cubic meter (ug/m^3) for the annual arithmetic mean concentration and 65 ug/m^3 for the 24-hour average concentrations.

The annual $PM_{2.5}$ standard is met when the three-year average of annual means is less than or equal to 15.0 ug/m^3. This three-year average is determined by calculating the quarterly averages for each year (with 75 percent data recovery in each quarter) to determine the calendar year average and then averaging the three years together.

The 24-hour standard is met when the three-year average of the 98^{th} percentile values is less than or equal to 65 ug/m^3. There must also be 75 percent data completeness for each year.

Please note that the data in the Table 17 are from dichot monitors only since the federal reference method program to monitor $PM_{2.5}$ did not begin until 1999.

Table 20. 1998-2000 Annual Average $PM_{2.5}$ Compliance (in Fg/m^3)

Proposed national ambient air quality standards: The three-year average of annual means is less than or equal to15 µg/m^3

1999-2000 $PM_{2.5}$ Annual Average National Ambient Air Quality Standard Compliance Values, by County

	Sites with Exceedances			Sites in Violation
	1998	1999	2000	
Cochise	0	0	0	0
Coconino	0	0	0	0
Gila	0	0	0	0
Maricopa	0	1	1	3
Mohave	0	0	0	0
Navajo	0	0	0	0
Pima	0	0	0	0
Santa Cruz	0	1	0	0
Yavapai	0	0	0	0
Yuma	0	0	0	0

Summary: 25 of 25 dichot monitors in compliance for 1998-2000

Table 20. 1998-2000 Annual Average $PM_{2.5}$ Compliance (in Fg/m^3)

City or Site Dichot Monitors	1998	1999	2000	Three-Year Avg
Cochise County				
Douglas, Red Cross	6.8	7.9 #	7.1	7.3
Coconino County				
Flagstaff, Middle School	4.7	4.9	4.7	4.8
Gila County				
Hayden, Old Jail – ADEQ	8.9	9.7	9.2	9.3
Miami, Golf Course	6.3	6.2	6.1	6.2
Miami, Ridgeline – PDMI	4.2	4.6	4.4	4.4
Payson	10.9	9.8	10.0	10.2
Maricopa County				
Estrella	7.1	8.9	7.7	7.9
Higley	9.4	11.1	10.0	10.2

Table 20. 1998-2000 Annual Average $PM_{2.5}$ Compliance (in Fg/m^3)				
City or Site Dichot Monitors	**1998**	**1999**	**2000**	**Three-Year Avg**
Palo Verde	5.5	5.6 #	4.9	5.3
Phoenix, ASU West	8.3	9.1	8.5	8.6
Phoenix, Greenwood – ADEQ	14.7 #	15.3	16.3	15.4
Phoenix, JLG Supersite	10.9	10.8	10.4	10.7
Tempe, Community Center	9.4	10.1	10.0	9.8
Mohave County				
Bullhead City, ADEQ	3.5	4.0	4.7	4.1
Pima County				
Organ Pipe Cactus National Monument	3.7	3.9 #	4.2	3.9
Rillito, ADEQ	N/A	8.8 #	8.8	N/A
Tucson, Craycroft – ADEQ	6.3	7.5	16.7	10.2
Tucson, Orange Grove – PDEQ	7.3	9.6	7.6	8.2
Tucson, U of A Central – ADEQ	7.5	7.2	7.8	7.5
Santa Cruz County				
Nogales, Post Office	12.5	16.0 #	12.8	13.8
Yavapai County				
Clarkdale, ADEQ	4.5	4.7	4.1	4.4
Clarkdale, NW of Cement Plant (#2)	4.7	4.9	5.9	5.2
Clarkdale, SE of CTI Flyash Silo (#1)	5.1	5.3	6.4	5.6
Hillside	3.1	3.2	3.2	3.2
Nelson	3.6	4.1	3.8	3.8
Yuma County				
Yuma, Juvenile Center	8.3	7.9	9.8	8.7

 # – Annual avg based on less than 75 percent data recovery in one or more calendar quarters
N/A – Data not available or annual average not able to be calculated due to insufficient data

Table 21. 1998-2000 24-Hour Average $PM_{2.5}$ Compliance (in Fg/m^3)

Proposed national ambient air quality standards: The three-year average of the 98th percentile values is less than or equal to 65 Fg/m3.

Note: The three-year average is rounded to the nearest 1 Fg/m^3 for comparison to the standard.

1998-2000 $PM_{2.5}$ 24-Hour Average National Ambient Air Quality Standard Compliance Values, by County

	Sites with Exceedances			Sites in Violation
	1998	1999	2000	
Cochise	0	0	0	0
Coconino	0	0	0	0
Gila	0	0	0	0
Maricopa	0	0	1	0
Mohave	0	0	0	0
Navajo	0	0	0	0
Pima	0	0	0	0
Santa Cruz	0	1	0	0
Yavapai	0	0	0	0
Yuma	0	0	0	0

Summary: 24 of 24 dichot monitors in compliance for 1998-2000

Table 21. 1998-2000 24-Hour Average $PM_{2.5}$ Compliance (in Fg/m^3)

City or Site Dichot Monitors	98th Percentile Observations			Three-Year Average
	1998	1999	2000	
Cochise County				
Douglas, Red Cross	12	17.0	12.4	14
Coconino County				
Flagstaff, Middle School	8.1	9.7	12.4	10
Gila County				
Hayden, Old Jail – ADEQ	21.0	20.1	18.7	20
Miami, Golf Course	10.2	10.6	11.8	11
Miami, Ridgeline – PDMI	7.7	8.4	10.3	9
Maricopa County				
Estrella	18.5	19.3	23.4	20
Higley, ADEQ	18.1	21.3	25.8	22
Palo Verde	10.4	10.5	10.5	11

Table 21. 1998-2000 24-Hour Average $PM_{2.5}$ Compliance (in Fg/m^3)				
City or Site Dichot Monitors	**98th Percentile Observations**			**Three-Year Average**
	1998	**1999**	**2000**	
Phoenix, ASU West	21.8	16.1	17.1	18
Phoenix, Greenwood – ADEQ	47.1	29.8	114.2	64
Phoenix, JLG Super Site	28.2	25.4	25.2	26
Tempe, ADEQ	23.3	24.0	20.5	23
Mohave County				
Bullhead City, ADEQ	14.1	7.2	8.3	10
Pima County				
Organ Pipe Cactus National Monument	6.8	6.5	7.3	7
Tucson, Craycroft – ADEQ	12.3	12.6	50.7	25
Tucson, U of A Central – ADEQ	15.4	11.8	13	13
Santa Cruz County				
Nogales, Post Office	34.4	67.4	34.6	46
Yavapai County				
Clarkdale, ADEQ	6.8	7.5	5.5	7
Clarkdale, NW of Cement Plant (#2)	11.3	10.6	14.4	12
Clarkdale, SE of CTI Flyash Silo (#1)	11.3	9.0	15.7	45
Hillside	5.6	6.9	8.8	7
Nelson	7.1	8.0	9.0	8
Yuma County				
Yuma, Juvenile Center	15.5	15.3	46.1	25

 # – Annual average based on less than 75 percent data recovery per one or more calendar quarters.

Visibility Data

Visibility monitoring is of three types: aerosol, optical and scene. Aerosol measurements are described elsewhere in this report because those measurements are used differently in characterizing visibility impairment. The chemical species that compose a particulate sample have different extinction efficiencies. Extinction efficiency is the extent to which an individual or a specific particle will either scatter or absorb light, thus blocking the light's path to one's eye. The overall affect of particles can be estimated by summing the effect of all the component species. This method is the primary approach used in the draft national regional haze rule for estimating present visibility and charting trends for future plan reviews.

Optical measurements can be taken by several monitors designed to characterize different optical phenomena. For example, the nephelometer that ADEQ uses frequently, measures light scattering by particles. The aethalometer characterizes how much light is absorbed by particles in the atmosphere. A transmissometer measures the total extinction from all processes. Data collected by each of these instruments can be represented by several different measurement units, including deciview, inverse megameters and visual range. The deciview is similar to the decibel, which is used to measure noise (sound) levels, and represents how the perception of visibility changes in a linear fashion. The inverse megameter is a representation of the ratio between how much light is not received by a sensor compared to the amount of light that leaves a source. Finally, visual range, the most familiar representation, quantifies how far one can see. One of the longest records of visibility conditions is human observation of visual range at airports.

Scene information is basically photographs, which can provide insight into the structure of and the extent of haze in the atmosphere. Another common use of photography is to establish a baseline "clean scene," and estimate how much the view is obscured in other photos. Please refer to the ambient air quality monitoring report, which begins on Page 1, for more information on visibility monitoring.

Class I Areas

In anticipation of the federal regional haze rule, ADEQ, undertook development of a visibility monitoring program directed at Class I areas in partnership with Arizona's federal land managers in 1997. The aim is to collect data at all of Arizona's Class I areas. Based on the regional haze rule, five years of data will be needed to determine baseline and projected visibility conditions. The IMPROVE program consists only of aerosol sampling, so ADEQ will jointly operate sites by installing nephelometers that measure light scattering. Since IMPROVE aerosol samplers will only operate every three days and represent 24-hour averages, taking continuous measurements provides insight into variation in visibility impairment with time, along with advancing the understanding of the relationship between particles and light scattering.

Table 19 summarizes the 1998, 1999 and 2000 nephelometer data from locations in or near Arizona Class I areas. The data are summarized into three categories for all hours: the average visibility of the dirtiest 20 percent of the sampled hours, the mean visibility of all hours and the average visibility of the cleanest 20 percent of the sampled hours.

Urban Haze

In addition to the 24-hour PM_{10} samples, ADEQ has collected six-hour samples of PM_{10} and $PM_{2.5}$. The six-hour samples were collected in the Phoenix and Tucson metropolitan areas for the morning hours (5 a.m. to 11 a.m.). The 1999 morning hours' PM_{10} and $PM_{2.5}$ observations are summarized in Tables 20 and 21.

Along with the particulate matter sampling, ADEQ also operated transmissometers and nephelometers in Phoenix and Tucson. Data from these instruments for 1998, 1999 and 2000 are presented in Table 22. The data are separated into categories for all hours and for six-hours. Each category is further summarized into the average visibility for the dirtiest 20 percent of the sampled hours, the mean visibility of all hours and the cleanest 20 percent of the sampled hours.

Table 22. Visibility in Class I Areas (Nephelometer Data in Mm^{-1})				
Site	**Year**	**All Hours**		
		Dirtiest 20 Percent	**Mean**	**Cleanest 20 Percent**
Humboldt Mountain	1998	24	9	0
	1999	25	11	2
	2000	28	14	4
Mount Ord	1998	29	12	2
	1999	22	11	3
	2000	24	11	3
McFadden Peak (site closed in 2000)	1998	25	10	2
	1999	18	7	0
	2000	N/A	N/A	N/A
Muleshoe Ranch	1998	24	11	4
	1999	19	10	4
	2000	22	11	4
Rucker Canyon	1998	32	13	3
	1999	19	9	3
	2000	18	8	1
Sycamore Canyon	1998	N/A	N/A	N/A
	1999	27	13	4
	2000	28	12	3
Tucson Mountain	1998	29	12	2
	1999	24	14	6
	2000	23	12	5

N/A – Not available

Table 23. Phoenix Metropolitan Area Six-Hour (5 a.m.-11 a.m.) PM_{10} (total) and $PM_{2.5}$ (fine) (in µg/m^3)							
Site	**2000 Annual Avg**		**Maximum**		**2nd Highest**		**Samples**
	Total	**Fine**	**Total**	**Fine**	**Total**	**Fine**	
ASU West	32.2	9.1	194	33.0	76	22.8	62
Estrella	32.4	13.0	86	46.2	77	42.2	41
Higley	57.8	8.4	202	23.2	184	19.8	38
JLG Supersite	36.4	10.6	154	28.8	77	27.1	59
Tempe, ADEQ	34.8	9.4	93	25.4	85	22.6	58

Table 24. Tucson Metropolitan Area Six-Hour (5 a.m.-11 a.m.) PM_{10} (total) and $PM_{2.5}$ (fine) (in µg/m^3)							
Site	**2000 Annual Avg**		**Maximum**		**2nd Highest**		**Samples**
	Total	**Fine**	**Total**	**Fine**	**Total**	**Fine**	
Corona de Tucson	18.8	5.7	91	12.2	49	10.5	61
Craycroft	N/A	N/A	145	36.9	71	23.8	61
Orange Grove	45.5	11.3	122	22.3	93	18.8	61
South Tucson	32.3	8.4	98	38.2	58	17.9	60
U of A Central	30.1	8.8	160	38.6	86	17.9	60

N/A – Not available

Table 25. Phoenix and Tucson Urban Haze Data 1998-2000 (in Mm^{-1})							
Site	**Year**	**All Hours**			**5 a.m.-11 a.m.**		
		Dirtiest 20 Percent	**Mean**	**Cleanest 20 Percent**	**Dirtiest 20 Percent**	**Mean**	**Cleanest 20 Percent**
Phoenix Transmissometer	1998	135	79	46	138	85	51
	1999	125	71	38	124	75	42
	2000	131	73	38	135	80	42
Phoenix Nephelometer	1998	91	35	10	75	34	13
	1999	88	36	11	74	36	14
	2000	90	38	12	79	38	15
Tucson Transmissometer	1998	N/A	N/A	N/A	N/A	N/A	N/A
	1999	97	60	36	111	67	39
	2000	101	57	27	115	66	31
Tucson Nephelometer	1998	44	20	4	47	23	6
	1999	43	23	10	42	24	11
	2000	40	20	8	41	22	11

N/A – Not available